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COMPLETE SOLENOID CONTROL SPEEDS OLEAN'S CONVEYOR SYSTEM

Olean Glass Company Utilizes 100 Per Cent Solenoid Controlled System for First Time in Carton Conveyor Layout.

By LOUIS H. CARGILL

There are many places in a glass plant where production bottlenecks can occur but in no one place is it more important to insure smooth, continuous operation than at the packing table, after the glass container has been sent through the lehr.

In recognition of this factor in plant layout and with the constantly increasing demands for glass containers, Olean Glass Company, Olean, New York, has installed a new carton conveying system. This project has consolidated carton conveying operations into one complete unit where formerly it was handled in two separate places in the factory.

The first step in the planning of the new system was the acquisition of a new building to house the carton assembly department. By necessity this building could not be placed very close to either of the two lehr rooms. However, the difficulty which the location of the building presented was overcome by ingenious planning of the actual conveying apparatus.

The two lehr rooms, although in parallel positions, were separated by several buildings and a railroad track, hence any system that was to function efficiently would necessarily have to serve both lehr rooms with equal speed and dependability. The lehr room closest to the carton assembly department lies some 350 feet distant. To overcome the disadvantages presented by the distances between the two packing stations and the carton assembly building a prerequisite seemed to be a system built well above floor level and remotely controlled by electric solenoids by a "dispatcher" who is located at a central station.

One of the most important considerations in laying out the system was the fact that each of the two packing stations must be accommodated with the particular style of carton required for packing the type of ware coming through the lehr. This might not seem to be a difficult problem but with each lehr at times annealing two types of containers requiring two different styles of cartons provision had to be made for this factor. The solution of this problem was found in the designing of double-width gravity feed chutes with a separator in the center. As the occasion demands, of course, both sides of the chutes can be used for one type of carton by loading both sides of the chute. There are 12 such double width chutes in the system.

In designing the system for overhead travel it was necessary to provide a booster to elevate the empty carton to the level of the power driven belt. This was done by a rolling loader and inclined belt arrangement. This loader, Figure 1, can be operated from any point in the entire

Fig. 1. Traveling loader which can be operated at any point in the carton assembly plant. Electric-cable allows for free movement while maintaining power.

Fig. 2. Top view of loader at point at which it contacts the power driven belt.

Fig. 3. Cartons reach power driven belt from loader and start journey to lehr rooms.

length of the carton assembly department. It is provided with an electric cable arrangement allowing for free movement and still maintaining the power. Figure 2 illustrates a top view of the loader at the point at which it contacts the power driven belt.

After the carton reaches the power driven belt on top it starts its journey toward one or the other lehr rooms as illustrated in Figure 3. In this view the electric switch has been thrown by remote control so as to deflect the cartons to the belt which serves the No. 1 lehr room which happens to be the furthest situated from the carton assembly building. From this point the cartons travel across two buildings and a railroad track in an enclosed tunnel where they again seek a lower level as shown in Figure 4. The movement of the cartons in this phase being from right to left they will now make a 90° turn and head into lehr room No. 1. Figure 5 shows the point at which cartons are shunted either to lehr room No. 1 or No. 2.

At this point it may be interesting to elaborate on the reasons for the deflecting mechanism. In order to appreciate what would have taken place if the deflector had not been thrown across the path of the cartons we suggest a study of Figure No. 6. Note the horizontal belt overhead and the gravity conveyors feeding down from it. Here the cartons are transferred from the power driven belt to the gravity chute. These chutes are constructed with skate wheels in order to allow a light article such as we are dealing with to gain momentum. This type of construction also permits the carton to come down in a straight position and avoids revolving.

In order to transfer the carton from the line belt to the gravity section it was necessary to provide a triangle of

Fig. 4. Cartons again seek a lower level after traveling across two buildings and a railroad track in an enclosed tunnel.

live rollers driven by an independent motor and switch. This arrangement permits the independent operation of the particular chute that is to be filled with cartons. The problem involved in the construction of a section such as this one can best be recognized by an appreciation of the fact that each of the rollers must be of different length yet all must be powered by one motor. The solution to the problem was found in the use of a combination of belts all synchronized. An examination of Figure 7 partially illustrates the hook-up employed. However, a brief outline of the progressive operation of this particular section of the system may be of interest.

When the motor is running and the live rollers are waiting to receive the cartons for the gravity they must first be caused to leave the power driven belt. This is effected by a gate or deflector which is thrown across the path of the carton at a 36½° angle. Experience indicates that this tangent offers the most efficient angle of transfer for this particular operation. The gate is operated from the operator's tower approximately 100 feet distant. Again of course the electric solenoid is the means of control. In construction the gate or deflector is fastened to a vertical shaft which is supported on a thrust bearing. Fastened to this shaft is an arm which in turn is connected to an electric solenoid and which when energized pulls the arm toward itself causing rotation of the shaft to which the gate is connected. The gate will remain in a fixed position until the switch is released and which will be the operator's next move after all the car-

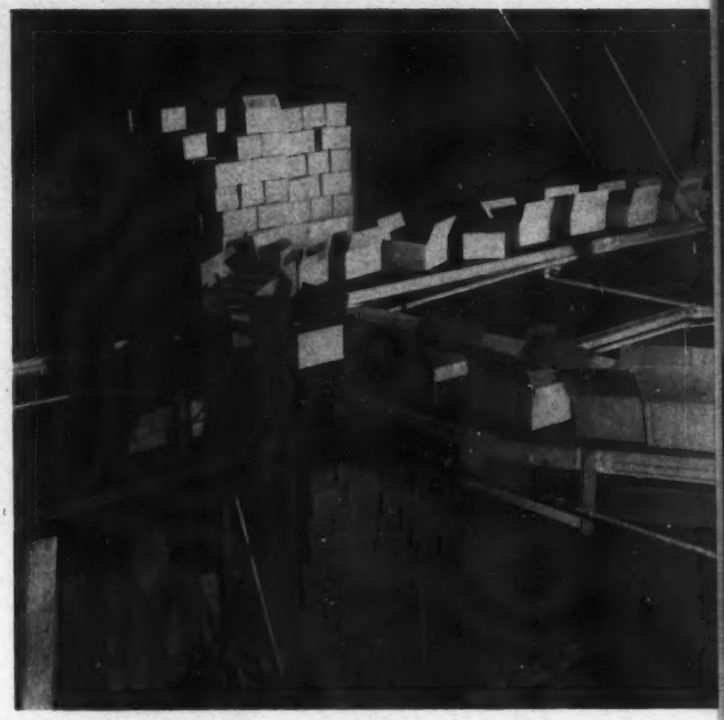


Fig. 5. Cartons at this point are shunted to either of the two lehr rooms.

Fig. 6. Point at which cartons are transferred from power driven belt to the gravity chute. Skate wheels permit lightweight cartons to gain momentum and avoid revolving.

Fig. 7. Close up of gravity chute showing combination belts which are synchronized to permit use of rollers of different lengths powered by one motor.

tons that are to be fed onto that particular chute have passed the deflector.

The very heart of this entire conveying system may be said to be illustrated in Figure 8. Here we see the operator or "dispatcher" using a microphone by means of which he gives instructions to the loading end of the system. He has a clear view of all the chutes and can immediately transmit to the loader the requirements of any chute both in quantity of cartons and sizes. A white placard for noting the needs of each chute will be seen just to the right of the electric solenoid switch box.

A view of lehr room No. 1 is shown in Figure 9. Seven double chutes, all operated as described feed cartons to the packers. Several of these gravity chutes exceed 75 feet in length.

In view of present day conditions a few highlights on materials used and construction methods should be interesting. Approximately 35 tons of steel were used in the frame work. Twenty-seven hundred feet of belting with rubber "Grip-Top" for inclined portions provides the conveying surfaces. For the non-activated sections 26,000 skate wheels and 5000 bearings for tubes are used.

All transmission equipment is Chain Belt Company's Rex Brand. Of particular interest to glass manufacturers who do not have readily available iron work facilities is the fact that all iron work was prefabricated to specification and shipped to the plant. Paul Cypress Iron works did the prefabricating work. It was completely assembled in 10 days time with the use of no other tools than wrenches.

The writer who designed the system wishes to acknowledge the collaboration of Mr. Walkerman Dugan and Mr. Franklin Pollock in the development and completion of this first conveyor project to utilize 100% electric solenoid control.

Fig. 8. The heart of the conveying system. Operator from this central station gives instructions to loader and regulates flow of cartons by electric solenoid control.

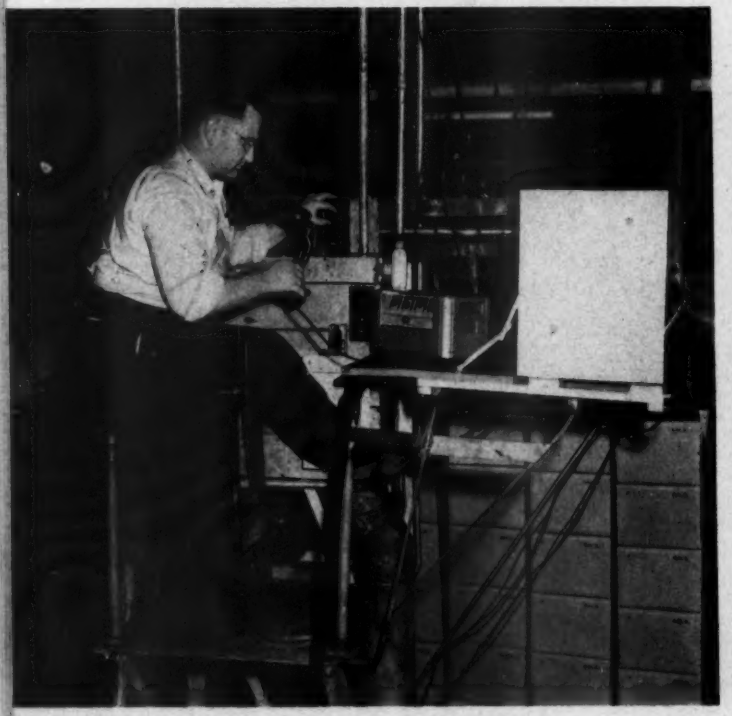


Fig. 9. Seven double chutes feed cartons to packers in lehr room No. 1.

COLORED GLASSES: EXTINCTION COEFFICIENTS FOR CHROMIUM AND COBALT

By S. R. SCHOLES and R. H. DOWS

This paper is an attempt to gather together, from various sources, information on the behavior of light as it passes through colored glass. It is hoped that this summary will be interesting and helpful to readers who are interested in glass color and in the mathematical treatment of the subject. The latter part of the paper is drawn from the Senior Thesis presented by R. H. Dows to the New York State College of Ceramics at Alfred.

Color in glass, as in other transparent substances, is known to be caused by the presence of elements or compounds which are capable of exercising specific absorption effects upon light. In ordinary thicknesses and for moderate concentrations, this absorption is by no means complete for any wavelength or color band. However, the effect upon visible light is such that certain color bands are transmitted to a greater extent than others, and the human eye perceives one color or tint to the exclusion of the others. For example, a blue glass absorbs yellow and other colors present in white light much more strongly than it absorbs blue, allowing the radiations producing blue to reach the eye in such preponderance that, apparently, only blue is seen. At the same time, as one may discover by looking at objects of various colors through a blue glass, other colors do come through, although much darkened. The eye is a poor means for estimating the quantitative transmission of a glass for different regions of the spectrum. Some instrument must be used that is independent of the sense perception of color. This is the spectrophotometer, whose findings express the color of a glass in terms of the decimal fractions of light transmitted at different wavelengths.

Elements and compounds show a great variation, not only in selective absorption and transmission, but in the degree of absorbing power which they possess. Cobalt and chromium are strong colorants, because they absorb very strongly, each in its particular spectral regions. Iron and copper are much weaker; fortunately, silicon, sodium, calcium and several other common elements have practically no power to stop visible light waves, nor does the oxygen with which they are combined; colorless glass thus becomes possible.

Transmission

The visible effect of selective absorption, as we have mentioned, is color. This effect, although it is produced in the negative manner of preventing other colors from becoming visible, must be considered in a positive way. The factor of transmission, or the fraction of the incident light of a given wavelength or band that is allowed to pass through a body, is the mathematical basis for all calculations of the coloring effect. This is sometimes expressed as percent transmission, but the decimal fraction must be the actual factor employed.

Factor of transmission for an actual pane or slab of glass involves not only the selective action of colorants in the glass, but reflectance. Light falling perpendicularly upon a polished glass surface is reflected back to the extent of about four per cent. This loss depends upon the index of refraction of the glass, according to the formula

$$R = \left(\frac{n-1}{n+1}\right)^2$$

in which R is the factor of reflectance, and n is the index of refraction. If n is 1.5, R = .04, making this a representative value for common soda-lime glasses. R might be as high as .053 for a flint glass of index 1.6.

The light actually entering the pane or slab is thus cut down to .96 of its original intensity. When the beam reaches the second or exit surface, the same amount of reflectance takes place, and only .96 of the light which has traversed the glass can escape. Therefore, even though the glass is perfectly colorless and transparent, it can transmit only .96 x .96, or .92 of the incident light. This happens to be substantially the same as subtracting .04 from 1.00, twice: 1.00 — .08 = .92. Logically, it is quite different. A suitable analogy for the arithmetic involved is found in trade discounts. Goods sold "less 50, 20, and 10 per cent" are not sold at 20 per cent of the list price, but at .50 x .80 x .90 = .36 or 36 per cent. When absorption values are high, and transmissions low, mere adding of absorbed fractions leads to absurd negative results. Multiplication of the transmission factors is necessarily the only suitable procedure.

To be sure, these considerations apply only to polished surfaces. Treatment with exceedingly thin layers of certain fluorides, or with some varnishing liquids, or some types of etching, may reduce this reflectance. On the other hand, grinding or roughening by etching may cause additional, diffuse reflection. But in most commercial glassware, and in simple optical systems, we are dealing with polished surfaces, whose reflectance factor can be placed at 0.92 without serious error.

Since the reflectance factor is the same for all thicknesses and colors of glass, it will be convenient to use in the present discussion the word "transmittance" for the glass itself, between its surfaces, and "transmission" for the over-all fraction, including surfaces.

The color of a pane of glass is best pictured by its transmission curve, plotted by using wavelength as abscissa (horizontally) and transmission factor as ordinate (vertically). On such curves, the maxima or peaks indicate predominant colors, and the minima or hollows show relative absence of colors, or "cut-out." One is often astonished by apparent discrepancies between the color of a glass, as seen, and its transmission curve. The peaks may not seem prominent enough to account for the intensity of the color. It must be remembered that the eye is getting only a relative and inaccurate sense perception, influenced to an exaggerated extent by small differences in the intensity of luminous flux at different regions in the spectrum. Aesthetically, this eye-physiology makes the world more varied and beautiful; scientifically, it makes the eye almost useless as a critical judge of color in the quantitative sense.

Transmission curves change, not only in height, but in shape, as thickness of specimen or concentration of

colorant increases. A set of typical curves for a glass colored blue by 0.1 per cent cobalt oxide is shown in Fig. 1. It is evident that the lower transmissions decrease more rapidly than the higher ones, as thickness increases. The consequence is that the 4-mm. thickness transmits very little red, orange, yellow or green, while the peak in the blue-violet remains quite high, and infra red comes through quite strongly. Visually, the 4-mm. thickness is much "bluer" than the thinner ones. Actually, it transmits less blue, but the peak in the blue-violet accounts for the rich color.

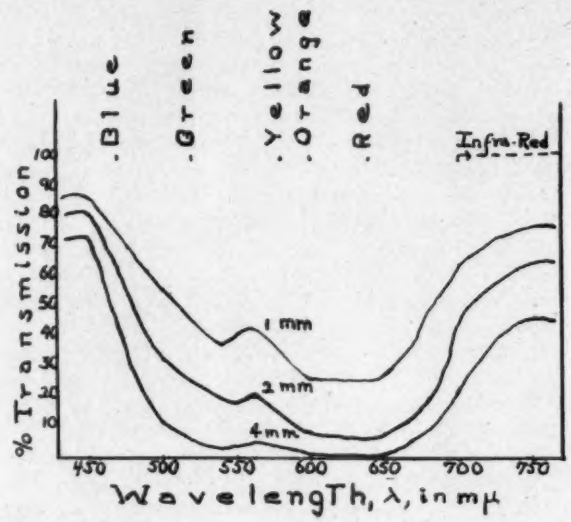


Fig. I

Calculation of Transmittance

When the transmittance of a piece of glass is considered apart from any surface effects, three quantities must enter into the calculation. These are: t, the thickness, usually expressed in mm.; c, the concentration of the colorant, expressed in molecular weight per unit volume, usually gram-mols per liter; and ϵ, the extinction coefficient specific for the colorant and the wavelength of the light and referring to unit thickness. These factors, thickness, concentration, and specific absorbing power or coefficient of extinction combine to produce d, the optical density. This is defined as the logarithm of the reciprocal of the factor of transmittance, T; that is,

$$d = \log \frac{1}{T} = -\log T$$

At first glance, optical density seems to be an awkward expression. Perhaps a concrete illustration will serve to show the logic of its origin and its usefulness for the matter in hand. Suppose that a 1-mm. thickness of a piece of glass transmits 0.90 of the light of a certain wavelength. It is necessarily true that a 2-mm. thickness will transmit $(0.90)^2 = 0.81$ of the light. But log 0.81 = 2 log 0.90. Since these numbers are both less than unity, their complete logarithms are negative. Hence we may also write

$$-\log 0.81 = -2 \log 0.90$$

This brings us to the easy step that the density of the 2-mm. thickness is twice the density of the 1-mm. thickness, and the utility of this method of expressing density is easily realized. Therefore, thickness enters as a direct multiplier when density is being calculated, but it must come in as an exponent when transmittance is calculated; that is,

$$T_t = T_1^t$$

taking logarithms of both sides of this equation,

$$\log T_t = t \log T_1.$$

Similar considerations apply to the effect of quantity and kind of colorant used. We cannot say that twice as much colorant, for example, produces twice as much color; we can say only that it produces twice as much optical density. Hence the expressions c and ϵ must also be used as exponents in order to bring out the proper logarithmic relationships.

These ideas are combined in Beer's Law, which we may write

$$T_t = T \cdot 10^{-tc\epsilon}$$

in which T_t represents the factor of transmittance for thickness t, and T represents unit intensity of the light entering the actual glass.

Taking logarithms of both quantities, we have:

$$\log T_t = \log T - tc\epsilon$$

But log 1 is 0, hence

$$\log T_t = -tc\epsilon, \text{ and}$$
$$-\log T_t = d_t = tc\epsilon$$

From this, $\epsilon = \frac{d_t}{tc}$, numerically, and we arrive at a means of calculating the extinction coefficient.

Some interesting corollaries derive from the last equation. When $\epsilon = 0$ (no colorant or absorber being present), $d_t = 0$, and $T_t = 1$, or unit transmittance. When t = 1 (unit thickness), $\epsilon = \frac{d}{c}$, and $c = \frac{d}{\epsilon}$. Therefore, ϵ is easily calculated when density and concentration are known, also, the concentration necessary to produce a certain density can be found, when the extinction coefficient is established. These calculations apply, of course, only to specific, relatively narrow wavelength bands.

From optical density to transmittance is a comparatively simple step, involving only careful treatment of logarithms, and using the relationship: d = —log T, log T = —d and T = the antilogarithm of this *minus* logarithm.

for example, suppose d = 0.0706.

Then log T = — 0.0706. This must be rearranged into the usual form, with proper characteristic, and becomes log T = $\bar{1}$.9294 (the mantissa or decimal part being always positive) or 9.9294—10. From a table of logarithms, it is found that .9294 is the logarithm of the number sequence 85; a characteristic of minus 1 means that the first significant figure is just at the right of the decimal point, so that T = .85.

Conversion of transmittance to transmission, T', which takes into account the surfaces and their reflectance, is accomplished by multiplying by the factor of reflectance. If this is the usual .92, T' = .85 × .92 = 0.78. From measured transmission to transmittance and to density, or directly from transmission to density, one proceeds by reverse calculations.

It may be unnecessary to add that transmission, as of a goggle lens, is often measured photometrically for total visible light, but the same relationships and calculations apply.

The Effect of Thickness

We have already noticed that optical density is proportional to thickness; therefore, in order to calculate density at unit thickness, which becomes a necessary value for the calculation of extinction coefficient, we divide the density by the thickness. Conversely, density at any given thickness is found by multiplying density for unit thickness by the thickness. Further handling of the quotient or product for the calculation of transmittance or transmission, respectively, requires, of course, the careful attention to handling the logarithms which has already been mentioned.

The qualitative effect of thickness is familiar to everyone who has made or handled colored glass. The depth of color, or to put it another way, the amount of light absorbed seems to build up in amazing fashion. This may be better understood if we consider the example of a comparatively dark glass whose overall transmission is, say, 0.20. The density of this specimen is 0.6990. If its thickness is doubled, the density becomes 1.3980, which corresponds to a transmission value of 0.04. This amounts, of course, to the square of the former transmission. It means that in this particular instance, only one-fifth as much light gets through when the thickness is doubled. At higher transmission values, although the same relative change in optical density takes place, doubling the thickness brings about smaller proportionate reductions in transmission.

The Determination of Coefficient of Extinction

Although the fact that different elements have widely different coefficients of extinction is thoroughly well known, and these values have been determined by numerous investigators, the actual numbers have not been made available in literature accessible to most readers. Therefore, it seemed advisable to make a quantitative study for two elements, with the realization that the facilities at hand and the time allotted for thesis work in this college could not be expected to yield highly accurate results.

Cobalt and chrome were selected for study because they are commonly used as colorants and because they have unusually high extinction coefficients. A description of the procedure employed and a report on the results obtained will form the remainder of this article.

Experimental Procedure

The following standard batch was used in all the experiments, the only differences being the amounts of coloring oxide added.

Batch		*Glass Composition (calc.)*	
Sand	700 g.	SiO_2	74.4
Soda Ash	280 g.	Na_2O	17.4
Burnt Dolomitic Lime	77 g.	CaO	4.8
		MgO	3.4

Melts were made in groups of six or eight, so that the effect of varying furnace atmosphere could be, to a large extent, eliminated. When the glass was completely melted and reasonably free from bubbles, gathers were made on the glassblower's pipe and balls were blown, having a diameter of approximately six inches with a wall thickness varying between one and two mm. From these balls, selected squares were cut and flattened on graphite slabs in a small furnace. The resulting panes served as specimens for the Coleman spectrophotometer. Measurements were taken of at least three specimens from each melt. Thicknesses were determined by micrometer caliper.

For a few of the compositions, specimens were prepared by grinding and polishing. These yielded results which agreed very well with the measurements on the specimens which had no other treatment than fire polishing.

In order to avoid the need for correction for reflectance, the measurements of transmission were made with the instrument adjusted against a pane of clear, colorless glass consisting of a microscope slide. Results obtained, when the microscope slide was used in its original polished condition and when it had been put through the same heat treatment accorded the colored specimens, which necessarily involved some marking of the surface by the graphite, showed no appreciable difference. The measured values were accordingly taken as measurements of transmittance of the glass for the measured thicknesses. These values were reduced to transmittance for unit (1-mm.) thickness and averaged for each composition before the final calculation.

Chrome-Green Glasses

A series of melts was made, using the base glass with additions of chromic oxide (Cr_2O_3), together with equal amounts of antimony oxide to provide for reduction of any CrO_3 that might have formed during the melting. The specific gravities of the glasses were determined. These values, ranging around 2.47, were used in calculating concentration of the chromic oxide in gram-mols per liter. Whether the absorption effect is laid to the oxide or to the element makes no difference here, because the gram-atomic (Cr) and gram-molcular (Cr_2O_3) concentrations perforce are the same numbers.

Transmission measurements were made with a slit width in the spectrophotometer which gave a 30 mμ band, centered at the indicated wavelength. The wavelengths selected for readings and recorded in the tabulations are those regarded as typical for five colors in the visible spectrum, viz: blue, 470; green, 520; yellow, 580; orange, 600; and red, 650 mμ. Measurements are recorded to the nearest tenth per cent, but the accuracy is not greater than one-half per cent, or ±0.005 in the factor of transmission. Values for unit (1-mm.) thickness were then calculated.

TABLE I.

Glass	*% Cr_2O_3*	*c*	*Transmittance for 1-mm. thickness, at wavelengths: 470*	*520*	*580*	*600*	*650*
I	0.10	.01625	.878	.959	.956	.929	.874
II	0.15	.02437	.821	.936	.931	.893	.816
III	0.20	.03250	.782	.924	.918	.872	.777
IV	0.25	.04062	.735	.907	.905	.844	.730
V	0.30	.04875	.688	.888	.879	.811	.677
VI	0.35	.05687	.662	.875	.867	.791	.653
VII	0.40	.06500	.621	.859	.851	.763	.613
VIII	0.45	.07312	.587	.842	.834	.741	.577
IX	0.50	.08124	.539	.819	.808	.707	.533

(*Continued on page* 317)

FOAM GLASS

Part II of a Series of Articles on the Development and Uses of Foam Glass

By E. L. KREIDL

PREPARATION OF FOAM GLASS

It will be convenient to distinguish between four different methods for the preparation of foam glass:

A. From Seedy Glasses.

B. From Glasses Containing Special Ingredients Causing Gas Evolution in the Softening Range.

C. By Introducing Gases into Molten Glass.

D. By Introducing Gases into Sintering Crushed Glass.

This classification is arbitrary and many of the processes described in literature are combinations of some of the above methods.

Regardless of which particular method will be applied for the production of foam glass it will be necessary to observe several general conditions to obtain satisfactory results. During introduction of the gas bubbles the glass has to be sufficiently fluid to completely envelop them and to be sufficiently viscous to withstand the gas pressure within the gas bubbles. The glass also should not be so fluid, nor kept so fluid for a sufficiently long time as to allow the bubbles to rise to the surface. Also regardless of the particular method used it may be advantageous to apply a partial vacuum over the surface of the soft glass to help the individual gas bubbles to expand and to create a reduced gas pressure in them, which, of course, will substantially increase the heat and sound insulation of the finished product. On solidification of the foam glass the walls surrounding the vesicles will have to be sufficiently strong to withstand any pressure difference between the surrounding atmosphere and the gas cells. In order to comply with the various requirements different temperatures may be applied during the various stages of the manufacture of foam glass. In case the pressure within the gas cells is less than atmospheric pressure the foam glass will have to be sufficiently solidified before being exposed to the outside atmosphere.

A. Preparation of Foam Glass from Seedy Glasses

The fact that the gases present in a glass melt will be released and froth up a glass melt when subjecting it to a vacuum has been observed long before anybody thought of preparing foam glass for technical purposes. Washburn, Tootitt and Bunting[8] found in 1920 that at 1200°C. a glass melt if suddenly brought under vacuum will froth up and increase its volume sixfold. That a glass with an exceedingly high water content swelled up on heating and formed a pumice-like mass was observed by Barus[11] in 1900. Similarly volcanic glass, obsidian, had been converted into a pumice-like material by preheating it to 900°C. and dropping it down a shaft furnace against a rising draft of hot gasses.

The behavior of gases in glass has been extensively studied both from a theoretical and a practical point of view, especially in connection with the fining problem. A comprehensive survey of the work in this field can be found in a paper by Weyl and Pincus[7] while for the purposes of this paper it will suffice to outline just the most important facts which may be utilized in converting a gas containing glass into a foam glass. The gases which, as a rule, are to be found in a glass melt may originate both from the raw materials which have been used in making the melt and from the furnace atmosphere. Thus, carbon dioxide may be introduced by means of carbonates, water by means of hydrated boron compounds or aluminum hydrate, and sulfur dioxide may be introduced by means of salt cake. Both water and sulfur dioxide may also be taken up from the furnace atmosphere. The presence of barium and lead will also favor the presence of oxygen gas. These gases will be present in the melt partially as seeds and partially they will be dissolved in the melt. In order to remove any gas bubbles from the melt and to prevent formation of more bubbles the glasses are subjected to a fining process and various methods are known to accomplish this. The best known method is the use of arsenic as the fining agent. In the first stages of melting arsenic is oxidized to form arsenates by means of saltpeter. At higher temperatures, that is in the fining range, the arsenates split off oxygen and the reduced arsenic volatilizes and escapes the melt. The split off oxygen as it bubbles through the melt acts as a vacuum for the other gases and accordingly sucks them out of the melt and removes them therefrom. Salt cake as a fining agent acts in a similar way, the oxygen being provided by the thermal decomposition of SO_3 into SO_2 and O_2. Fining also can be obtained by having a strong vacuum over the glass. For obvious reasons this method can not be used for general glass melting practice, but it has been suggested by Vello[9] for the production of special glass for pump stems. When also taking into account that the glass melt, as a rule, will be supersaturated with carbon dioxide the following fining methods will be readily understood. The stirring of optical glass or the addition of wet organic materials as blocking agents serve the purpose to facilitate removal of the carbon dioxide. The same effect, finally, may also be obtained by raising the temperature after the melting is completed considerably so as to release all the gas.

It can be seen easily that our knowledge of the behavior of gases in glass can be directly applied to the production of foam glass. In this connection it may be interesting to note that incomplete blocking by the addition of green wood or potato peels has been used to simulate antique bubbly glasses. To obtain the desired effect it was merely necessary to gather and shape the glass before the blocking action was completed. However, in order to obtain a foam glass answering the requirements as outlined in a previous section it will not be sufficient just to interrupt fining when the amount of gases will be the greatest in the glass, but it will be necessary to expand the existing gas bubbles and to release additional gas bubbles by the application of a partial vacuum over the bubbly glass.

In order to increase the seediness of glass for this type of preparation of foam glass it was also suggested to add refractories, such as sand, diatomaceous earth and

the like to the molten glass, which refractories then will serve as nuclei for the formation of seeds.[15]

B. Preparation of Foam Glasses from Glasses Containing Special Ingredients Causing Gas Evolution in the Softening Range

The methods discussed in this section are based on the law of valency isobars which teaches that the lower valency compound of a substance will be increasingly stable with increasing temperature. Accordingly, substances the lower valency of which will be stable at the melting temperature of a glass and the higher valency of which will be stable in softening range of the glass, may be utilized for the preparation of foam glass due to their interaction with carbon dioxide and water in the glass. Thus titanium dioxide, chromic oxide, manganese dioxide and the like have a tendency to be converted to oxides of lower valency when incorporated in a glass melt, especially in the presence of reducing agents. When cooling the glass rapidly they will be frozen in in their lower valency state. However, when reheating them to temperatures in or somewhat above the softening range they will exert a strong reducing action on any carbon dioxide and water present in the glass and under conversion into their higher valency forms reduce them to carbon monoxide and hydrogen. Due to the fact that carbon monoxide and hydrogen are by far less soluble in the glass than carbon dioxide and water the softened glass will be expanded into a foam glass.

The mechanism of this type of reactions may be illustrated by a foam prepared from a raw batch to which chromic oxide and aluminum powder have been added. At the relatively high temperature used for melting glasses and under the reducing conditions which are warranted by the addition of the aluminum powder the chromic oxide will decompose to chromous oxide in accordance with the law of valency isobars:

$$Cr_2O_3 \xrightarrow[\text{reducing conditions (Al)}]{\text{high temperature}} CrO$$

On relatively quick cooling of the glass the chromous oxide will have no chance to reoxidize. However, on reheating to the softening range it will become unstable and exert a strong reducing action on the carbon dioxide and water which are present in the melt:

$$2CrO + CO_2 \xrightarrow{\text{softening range}} Cr_2O_3 + CO$$

$$2CrO + H_2O \xrightarrow{\text{softening range}} Cr_2O_3 + H_2$$

C. Preparation of Foam Glass by Introducing Gases into Molten Glass

The methods described in this and the following section are distinguished from the methods described in the preceding sections in that the gases are introduced into the glass from an extraneous source. The advantage of such processes which are more or less independent of the glass composition are self evident and it is not surprising that these methods, especially the one described in the next section, have practically replaced those described in the preceding sections.

Gas may be introduced into molten glass in a number of ways. Substances which react with the glass, such as calcium carbonate or barium sulfate[19] may be stirred into the glass. Gas may be stirred or whipped into the glass (egg beater method). The molten glass may be brought into contact with a liquid such as water and thus be permeated with water vapor or the like. When blowing air or steam into the molten glass use may be made of porous walls through which the fluid may be pressed into the glass.

Since lightweight slags are made from molten slag it is not surprising that practically all these methods have also been used for their preparation.

D. Preparation of Foam Glass by Introducing Gases into Sintering Crushed Glass

Theoretically there is little difference between the methods described in the preceding section and those in which the gas is introduced into sintering crushed glass. However, crushed glass as a raw material facilitates greatly even distribution of the gas bubbles in the glass, especially where solid gas evolving agents are used. As a matter of fact, the two most important practical processes for the production of foam glass consist in heating a mixture of crushed glass with calcium carbonate or carbon respectively. The crushed glass method, of course, may be also used with gases, such as air, or vapors, such as steam, under pressure as described in connection with the methods used for molten glass.

In most cases where gas evolving agents, such as carbon or carbonates, are used part of the gas bubbles in the finished glass will nevertheless be the air which has been entrapped in the interstices between the solid gas particles. The gas evolving agent proper will furnish the additional amount of gas to provide the over pressure necessary to bloat the glass. To attain the desired result it will be necessary to use as gas evolving agents substances which produce the gas at temperatures at which the glass is fluid enough to completely envelop the gas bubbles. If the crushed glass is not heated to sufficiently high temperatures or if the gassing agent evolves the gas at temperatures at which the glass is not fluid enough to envelop it the glass will just sinter to a porous material. Sintering of crushed glass at relatively low temperatures, accordingly, has been used in the manufacture of glass filters or porous glasses for other purposes.

As has been mentioned in the introduction excess pressure in the individual vesicles during the swelling process may lead to rupture of the walls and to the formation of a sponge structure. However, no mention can be found in the literature that formation of such a sponge structure has been observed. Most likely it may be assumed that when excess pressure leads to rupture of the walls the foamy mass will partially collapse and excess gas will be squeezed out. After pressure equilibrium will be re-established a foam glass of much denser structure will be formed. Accordingly, the addition of gassing agents will have to be so adjusted with respect to concentration and temperature that formation of excess pressure is avoided. It might also be possible, if the gassing agent is used in too great an amount, that the formation of gas bubbles in locations spaced too closely together may prevent formation of the desired foam structure and cause collapse of the glass in a way similar to that described above and thus, in spite of the great amount of gassing agent used, lead to a glass of greater density than would have been obtained with a smaller amount of the gassing agent.

(*Continued on page* 318)

THE FTC ELASTI-GLASS HEARING

During the course of a four-day hearing in Chicago, starting June 1, further testimony was taken before Charles A. Vilas, Trial Examiner of The Federal Trade Commission, in the matter of S. Buchsbaum & Company. The FTC has charged the Buchsbaum Company, manufacturers of various men's accessories, with misrepresentation of its product through use of the name Elasti-Glass, implying that the product which is made of Vinylite, a synthetic resin, is made of glass or contains glass.

At the previous hearing, held in Chicago in March, the respondent presented testimony by Mr. Harold F. Robertson, of the Union Carbide & Chemical Corporation of New York, the company which supplies the basic material from which Elasti-Glass is made. As the cross-examination of Mr. Robertson had not been completed when the March hearing adjourned, it was resumed at the start of the June hearing.

On direct examination Mr. Robertson had testified that in his opinion Vinylite and some other synthetic resins are organic glass because they have a random arrangement of molecules and high viscosity, in his opinion the main characteristics of the glassy state. On cross-examination an extended discussion took place as to his use of the term "glass." Particular attention was directed to his use of the word in one of the patents that had been issued to him for an invention relating to the preparation of a plastic inter-layer for safety glass.

Eldon P. Schrup, counsel for the FTC, stated that in questioning Mr. Robertson about his use of the word "glass" in his patent specification, he was trying to find out how Mr. Robertson used the word "glass" outside of the hearing. Mr. Robertson testified that his use of the word "glass" in the patent specification referred to "the inorganic product of fusion."

He further testified that whenever he used the word "glass" in any of his patent specifications he meant glass made from inorganic materials. Continuing his testimony, he said that he would consider unstretched Nylon to be glass. He also said that if Vinyon were stretched it might be glass and it might not.

In connection with a discussion of the necessity for randomness of arrangement of atoms or molecules, and the method of determining the existence of randomness or orientation by X-ray photographs, there was submitted to Mr. Robertson for examination a reproduction of an X-ray photograph which he said exhibited less orientation than he would expect to find in stretched, unplasticized Vinylite, and that the picture indicated that the material was "leaving the glassy state."

In answer to a question as to whether there was too much orientation for him to call the material glass, he said it was just on the borderline. The discussion between counsel which followed indicated that the picture represented an X-ray photograph of "the compression side of leaning structure of tree trunks."

During further cross-examination of Mr. Robertson it was brought out that a number of manufacturers and vendors of synthetic resin products who had been selling them under trade names containing the word "glass," or the term "glas," had stipulated with the Federal Trade Commission to discontinue the use of the word, or the term "glas." Included among these trade names was "Louvreglas."

Mr. Robertson's attention was directed to the fact that the manufacturers of "Louvreglas" had changed the name of their product to "Louvreplas." While he had previously testified that this usage was one of the items which had influenced him in considering the synthetic resins to be glass, he asserted that abandonment of the name "Louvreglas" did not alter his opinion.

At the conclusion of the cross-examination of Mr. Robertson the respondent called as a witness James Sachs, a divisional sales manager for A. Stein & Company. Mr. Sachs' testimony as to the experience of his company with the manufacture and sale of men's accessories under the trade name "Glass-Tex" followed along the same lines as the testimony of other manufacturers at previous hearings.

Other witnesses called by the respondent were Irving J. Rosenbloom head of the advertising agency which handles advertising for S. Buchsbaum & Company; Leonard Becker, chemist for S. Buchsbaum & Company; and Herbert S. Buchsbaum, president of the company. Mr. Buchsbaum's testimony dealt chiefly with the scope of the business done by his company, the amount spent for advertising, and the attitude of the trade and public towards his company's products.

At the conclusion of Mr. Buchsbaum's testimony the hearing was adjourned, and counsel for the FTC was directed by the Trial Examiner to advise him at a later date whether the FTC would offer any evidence in rebuttal. It is now understood that counsel for FTC has asked for a rebuttal hearing to be called later this summer.

Mr. C. W. Carlson, President of the United States Glass Company, Tiffin, Ohio, recently appeared before the Committee for Reciprocity Information in Washington, D. C., in behalf of members of the American Glassware Association and the American glassware industry to urge that no tariff reduction be made on all glassware entering this country under paragraph 218-F in the Trade Agreement with Mexico. He suggested that should a concession be desirable on "bubble glass" a time limit be set for the duration only and that the glass under discussion be clearly defined.

Mr. Carlson pointed out that while almost every country has a native glass industry the major part of crystal glassware for local consumption is usually imported. Native novelty goods are not competitive to the United States manufacturers and would be bought regardless of a tariff. If the Mexican glass manufacturers develop their factories to produce for their domestic market they could make Mexico independent of imports and cover a far greater field than they now do with bubble glass. They are not prohibited many metallic oxides for the manufacture of glass now barred in this country, which opens to them the United States colored glassware market for the duration at least. Consequently if tariff reductions remain in force after the duration, Mexico, with greatly lower labor costs, could offer a very serious threat to the existence of the industry in this country.

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During June

Compositions:

The initial patents in the Hood-Nordberg group under which Corning Glass makes its 96 per cent silica ware by a leaching and shrinking process were discussed in detail in the Nov. 1940 GLASS INDUSTRY. The starting compositions are glasses made of SiO_2, B_2O_3 and Na_2O (or other alkali). The glass articles are formed and then leached in acid to remove an alkaline glass and to leave a porous skeleton of nearly pure silica. A subsequent heat treatment shrinks the ware into dense form, without distorting it, and gives an article which could not have been formed from an initial composition so high in silica. Hall and Nordberg now report that breakage sometimes occurs in the acid leach due to the swelling or shrinking of the outer glass layers which are the first from which the alkalies are leached. The difficulty is eased (patent 2,286,275) by selecting the initial glass composition from a specific narrow range of compositions preferably containing alumina as an additional treatment, and by heat treating the glass at 500° to 600° C. before leaching it. The patent expresses the satisfactory composition ranges with and without alumina. It is technically interesting to note that a substantial amount of the alumina (which initially may be as high as 4%) is retained in the insoluble siliceous residue "thereby producing final glass compositions for which there is evidence that they are more stable against devitrification than the prior glasses."

Furnaces:

Fig. 1 shows a tank repair method invented by Henry H. Blau and Kenneth K. Knaell when they were associated at Charleroi, Pa. The patent, 2,284,797 was applied for in 1936 and is assigned to The Carborundum Co. When the bottom of the tank becomes worn and

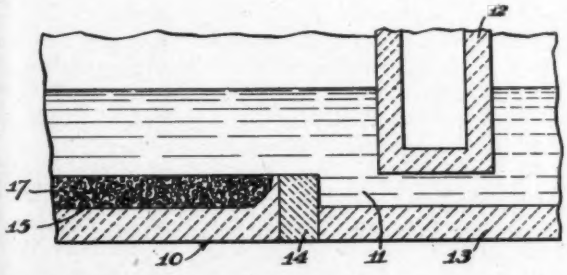


Fig. 1. 2,284,797: Blau and Knaell. To repair thin bottoms, fragments of fusion-cast refractories are preheated and sunk through the molten glass behind a throat well dam 14.

thin, relatively small pieces of dense, heavier than glass, cast refractory 17, are shovelled onto the glass and allowed to sink into place. To avoid cooling the glass and to prevent glass freezing to the refractory particles, the latter are preheated to approximately the glass temperature.

Feeding, Forming and Shaping:

To give semi-automatic control of the charge fed by a plunger device, John T. Wood of Bootle, Liverpool, England, in patent 2,288,381 provides a weighing pan on which pieces of glassware are periodically placed so that their variations may set in operation an electric circuit which operates an air valve by means of a solenoid to change pneumatically the upper and lower stops which govern the movement of the charging plunger.

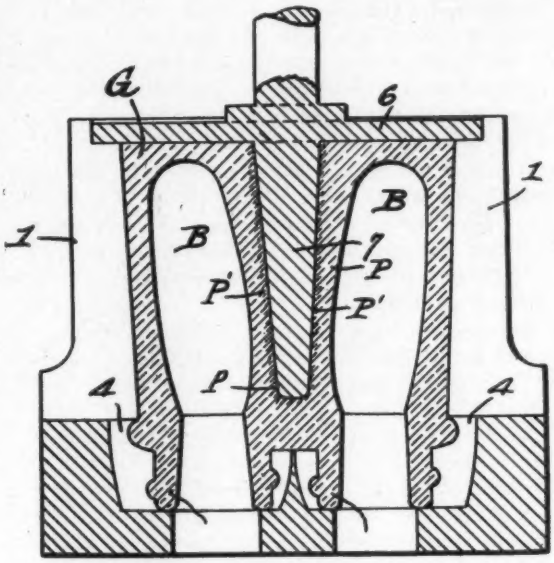


Fig. 2. 2,285,707: Garwood and Schlehr. In forming multiple compartment containers a cooling tongue 7 gives the partition wall a rigidity needed for the final blow.

An altogether different feeding device, as is required for forming ware from a continuous ribbon is described in patent 2,286,323, assigned by Walter C. Weber of West Hartford, Conn., and Edmund H. Wellech of Corning, N. Y., to Corning Glass Works. In this type of machine as described in earlier patents 1,790,397 and 2,263,126 the glass ribbon is flattened out after it leaves the forehearth, and the ware, for example lamp bulbs, are formed only from the central area of the ribbon. In this latest invention the flowing glass stream is flattened by means of a plow of such shape as to guide the surface glass toward the outer portions of the ribbon so that it will be left unused after the articles have been fabricated. This reduces the possibility that contaminated glass will find its way into the ware.

Details of improved cut-off apparatus for suction gathering machines of the Owens type are given in patent 2,285,325 issued to Joseph P. Benoit of Alton, Ill. (Owens-Illinois Glass Co.). Included in the mechanism are means individual to each mold unit by which each cut-off knife is dropped away from the blank mold before it is swung open to discharge the blank, such movement being independent of the time and place at which the knives on the other mold units are dropped.

Fig. 2 shows a step in a process for producing multiple-compartment, one-piece containers by a press and blow method. The inventors, Chas. B. Garwood and

Walter R. Schlehr (Carr-Lowrey Glass Co.) report that prior methods such as described in the Garwood patent 2,013,382 which was issued in 1935 are difficult to operate due to the higher temperature in the partition section which frequently allows this softer glass to be displaced or distorted during the final blow. The accompanying illustration from patent 2,285,707 represents an intermediate forming step. There has already been a down blow followed by a leveling compacting by means of downward pressing; a cooling tongue 7 which is believed to be a distinctive feature has been inserted into the glass, and the initial upward blow has taken place. Thereafter the tongue is removed and the blank is removed to a final blow mold. In the final blow the cavity left by the cooling tongue is collapsed. The cooling action of the tongue is said to give the center partition a rigidity of the same order as that of the glass in contact with the mold walls.

A rotary pressing machine patented by Robert P. Cassell of Jeannette, Pa. (2,287,512 to The Jeannette Glass Co.) utilizes a pressing table of small diameter in which the molds are closely spaced, and pressing is accomplished in the next station to that in which the charge is received.

The pre-stressed bottle mold invented by Otto H. Samuelson of Indianapolis, and described in the April 1942 GLASS INDUSTRY, is now covered by patent 2,286,310.

A method of foaming or granulating molten glass or slag is described in patent 2,286,078 granted to Marcel Gallai-Hatchard of London, assigned to Holland & Hannen and Cubitts Ltd., London, England. The molten material is poured onto a moving conveyor where it runs over a depressed area holding water which releases steam to foam the glass.

George B. Langer of Anderson, Ind. (Lynch Corp.) received patent 2,288,466 for a motor operated driving mechanism for a forming machine, which mechanism has associated with it the synchronizing apparatus for the charge feeder and the take-off conveyor.

A modified means of cooling glass articles before their removal from the forming machine is the principal disclosure in 2,284,796 issued to Walter K. Berthold of Rockville, Conn. (Hartford-Empire Co.). Fig. 3 gives an idea of how the invention is applied to a machine operated on the narrow neck principle. At the stage illustrated the shaped article has been inverted onto the cooling and discharging device 43. Cooling air is then blown against the exterior of the ware from 47 and 18 (the finish blow head) and through the hollow discharge device 43. This upward surge of air lifts the ware from contact with any metal, and supports it by the buoyancy of the air. One advantage of such a method is that cooling is commenced at both the inner and outer surfaces of the article quickly after its formation.

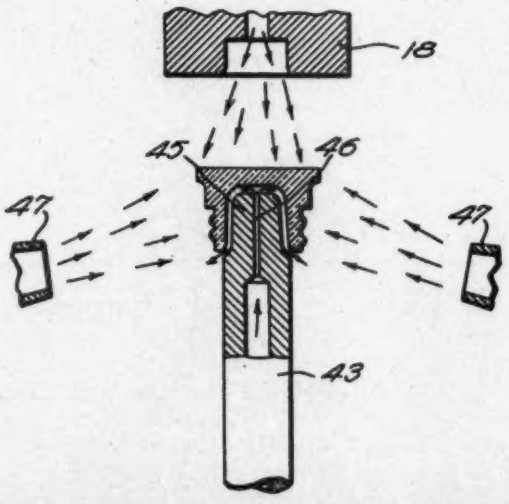


Fig. 3. 2,284,796: Berthold. To cool ware before its discharge from the forming machine, an air blast from below lifts it by buoyance from the discharge device 43.

In another Hartford-Empire patent 2,288,029, George E. Rowe of Wethersfield, Conn., details the successive steps for a complete machine-forming process for making relatively large thin walled articles such as electric light shades. The gather is obtained by suction means, sheared and brought by the blank or gathering mold into contact with a neck mold which contains a combined pressing and blow head assembly; the plunger rises to shape the blank into a form which has a supporting rim or neck finish portion, and the neck mold with plunger is then inverted to bring the blank into position for blowing in a finish mold. Blowing is accomplished through the hollow plunger.

Miscellaneous Processes:

Corning Glass compositions and tempering processes for making top-of-the-stove ware were discussed in the April 1941 GLASS INDUSTRY in connection with patents granted to J. T. Littleton, Wm. W. Shaver and Howard R. Lillie. Modifications of these processes have now been covered by patents 2,285,595 and 2,285,596 issued to the same trio. The object of these inventions was to produce glass articles with particular ratios existing between the maximum compressive stress induced in the outer glass layer by cooling and the maximum tensile stress within the ware. In the process of 2,285,595 the ratio of compression to tension is *high*, whereas the process of 2,285,596 is modified to give a *low* ratio and to give a relatively thick compression layer. The previously practiced methods of tempering heated glass by a prolonged application of an airblast, or by quenching in a bath of molten salts, naturally removes the heat from the ware at a gradually diminishing rate and gives a relatively slight thickness to the zone of compression. The result is the easy shattering of tempered glass by scratching through the surface layer, which has become a familiar lecture platform experiment. To achieve a deeper compression zone patent 2,285,596 provides a relatively mild chilling treatment for a brief period, and then one or more progressively more severe chills. For example, a glass article which was prepared by heating to 800° C. was first held in free air for 10 seconds, then for 3 seconds in a salt bath at 330° C., then for 30 seconds in a bath of the same composition at 160° C., and finally in air until cooled to room temperature. To achieve the opposite result described in patent 2,285,595, the chilling steps are progressively milder instead of stronger. Both inventions are explained by means of strain diagrams.

Also applicable to making tempered ware is the latest Hartford-Empire patent 2,288,012 (Chas. E. Mongan Jr.)

for a nozzle for cooling the interiors of bottles. The nozzle provides a wide range of adjustment for bottles of various sizes and shapes.

The familiar softness of plastics which allows them to be easily scratched is one property which gives an advantage to glass wherever the materials are competitive. This shortcoming of plastic lenses is attacked by Frederick J. Binda of Boston (Polaroid Corp.) in patent 2,287,546 by covering the lense surfaces with a thin film of glass. The film may be applied by blowing glass in the form of a bubble against the article to be coated as in Fig. 4. The wall of the bubble is deformed by contact with the plastic and takes the shape of the lens. Upon cooling, such of the glass as came in contact with the plastic while hot remains attached to it and the excess film is easily broken away. Glass lens-making processes are dealt with in patents 2,286,319 to Max Sunskes of New York, for holding the lens blank for pitching, and 2,286,886 to Albert L. Anderson of Minneapolis (Cosmet Corp.) for grinding facets.

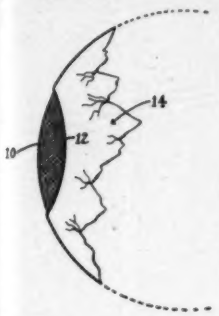


Fig. 4. 2,287,546: Binda. To give plastic lenses a tough surface a thin glass bubble is blown against the lens, and the excess 14, is broken away when cool.

Lamp-making and treating apparatus is described in patents 2,288,537 to Frank J. Malloy of Cleveland Heights, Ohio (General Electric Co.), 2,287,024 to E. T. Casellini of Salem, Mass. (Hygrade Sylvania Corp.), 2,285,181 to Wm. B. Wines of Downers Grove, Ill. (Western Electric), and 2,286,819 to Chas. M. Lee of Rochester, N. Y. (Eastman Kodak Co.). The Malloy patent covers a sealing machine for precision built lamps made by applying a cover glass to a cup-like reflector. The Casellini apparatus applies a luminous coating mixture to fluorescent tubes. The Wines patent describes a machine for making electric lamp filament supporting stems from individual lengths of glass tubing. The Lee patent describes an apparatus for holding lenses during the application of nonreflecting coatings.

Patent 2,284,832 granted to Donald G. Merrill of West Hartford, Conn. (Hartford-Empire Co.) for a lehr is a division from his patent 2,245,113 which was mentioned briefly in the April 1941 GLASS INDUSTRY.

A bottle inspection apparatus is covered by patent 2,286,836 which issued to Lawrence T. Sachtleben of Camden, N. J. (R.C.A.).

Patent 2,286,401 granted to Samuel J. Everett of Thornton Heath, England, concerns a method of manufacturing precision glass barrels for tubular syringes by a combination of hydraulic pressure and vacuum which fits the thermo-pastic tubes to a mandrel.

Of timely interest is the black-out lamp described in patent 2,286,657 granted to Kenneth P. Swanson of North Valley Stream, Long Island, N. Y., and assigned to Wabash Appliance Corp.

Plate and Sheet Glass:

To reclaim the glass from laminated sheet glass which is too defective to sell as a unit, Frank W. Hall of Brackenridge Pa. (2,288,524 to Pittsburgh Plate Glass Co.) supports the plate in an inclined position and heats it sufficiently to soften the bonding layer and to allow the lower sheet to drop away, as shown in Fig. 5. Another Pittsburgh Plate Glass Co. patent is 2,288,507 issued to Leroy S. Whitmire and Chester A. Juncker of Crystal City, Mo., for a glass bending frame. In types of bending apparatus which use flexible members such as wires, the contact of the wires with the glass during cooling results in streaks on the glass surface. In this latest apparatus the bending frame is removed from the furnace and a latch releases the wires on one side of the sheet while those on the other side stand free from the glass due to the angle by which the tongs support the sheet.

Means of reducing the wave or batter in sheet glass made by the Fourcault process are described in patent 2,287,136 assigned one-half to Adamston Flat Glass Co. and one-half to Rolland Glass Co. by Eugene Rolland and Chas. J. Richter of Clarksburg, W. Va. The purpose is to control the atmospheric conditions in the stretching and setting chamber so that there are uniform conditions across the width of the sheet. A pair of slotted conduits which extend across the width provide a means of blowing air against the sheet. The air circulatory system allows control of the air volume and its temperature, depending upon the source from which it is drawn from the furnace and how it is mixed with atmospheric air.

Patent 2,285,921 issued to Sylvester F. Grein and Pete G. Magrini of Belle Vernon, Pa. (Pittsburgh Plate Glass Co.) concerns a glass handling machine for automatically and mechanically handling glass sheets, for labeling the individual glass sheets, and for properly stacking them for packing.

Glass and Wool Fiber:

Each of the seven glass fiber patents reviewed in this section was assigned to the Owens-Corning Fiberglas

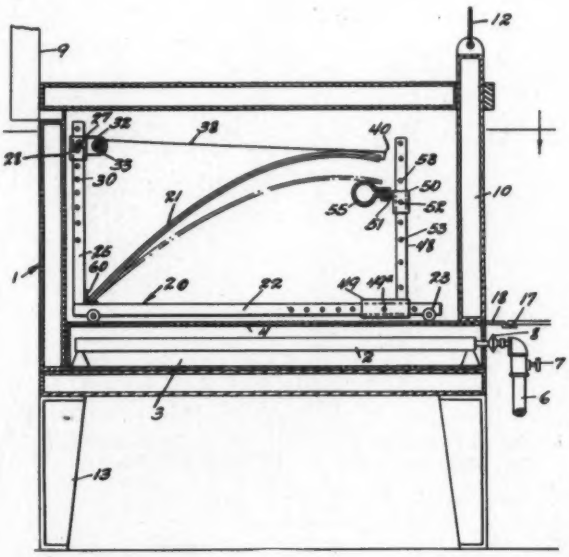


Fig. 5. 2,288,524: Hall. Imperfect laminated glass is supported by the upper sheet at 40, and heated until the lower sheet falls away.

Corp. Stuart M. Dockerty of Corning, N. Y., has patented a fiber producing apparatus, as illustrated in Fig. 6 which draws the fibers by a compressed air wiping action instead of by the jerk which is caused by some types of steam jets. The melting furnace 11 is entirely enclosed in a pressure chamber 19. As pressure builds up within the chamber the air issues as a high velocity jet from the slot in the bottom of the chamber. Compressed air at gauge pressures of from three to ten pounds will attenuate the glass fiber to the usual commercial diameter as rapidly as it can be melted. This is patent 2,286,903.

Piero Modigliani of Livorno, Italy, received patents 2,287,557 and 2,287,815 on applications filed March 3, 1939. The first of these patents provides an apparatus for continuously drawing and spinning fibers onto drums so that when one drum is filled it is replaced by another which is shifted into exactly the same position. This is accomplished by having drums mounted on shafts at the three apexes of an equilateral triangle, with a main turning shaft passing through the center of the triangular casting. In Modigliani's patent 2,287,815 on insulating felt or mat is made from a series of preformed ribbons or strips instead of from individual fibers.

A patent, 2,288,072, granted to Howard W. Collins of Newark, Ohio, discloses a method for making bonded mats or shaped products having various degrees of toughness, rigidity, and weight. One object is to replace the binder applying means by which a liquid binder is sprayed onto the fibers at their point of formation. Instead, the fibers are blown onto a conveyor which mats the fibers; then the binder is drawn into the mat successively from below and from above it in the form of binder dust carried in the air. An application from one direction would not penetrate the mat. The mat is then treated with heat or reacting fluids to set the binder.

Dale Kleist and Games Slayter of Newark, Ohio, received patents 2,287,006 and 2,287,007 covering different aspects of a new method of producing an interfelted mass of fibers. This involves cooperative functions of the steam blast for drawing the fibers, and the hood which directs the fibers onto a forming conveyor.

Of more general interest, because it describes a melting process whose use need not be confined to fiber manufacture, is patent 2,286,653, granted to Claus Siegfried of Dusseldorf, Germany, who filed his application papers in March, 1939, before the war began. Instead of feeding seed-free glass in the form of marbles, Siegfried provides a solid column of glass whose width approximates that of the furnace. Means are described of supporting this stock and of feeding it into the furnace at the same rate the lower end is melted.

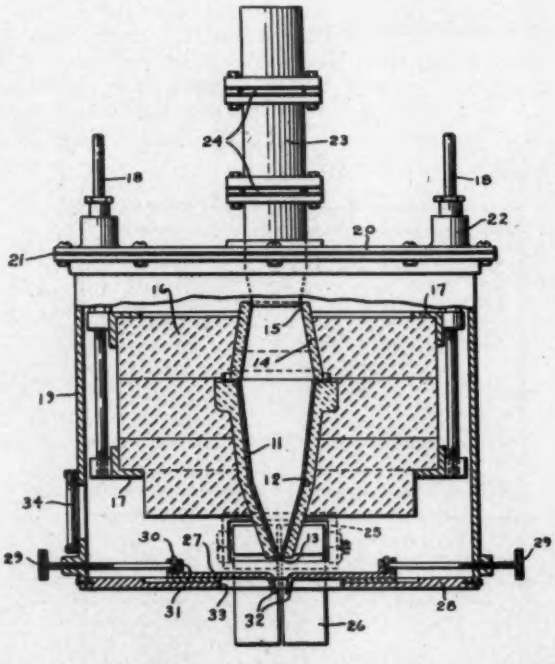
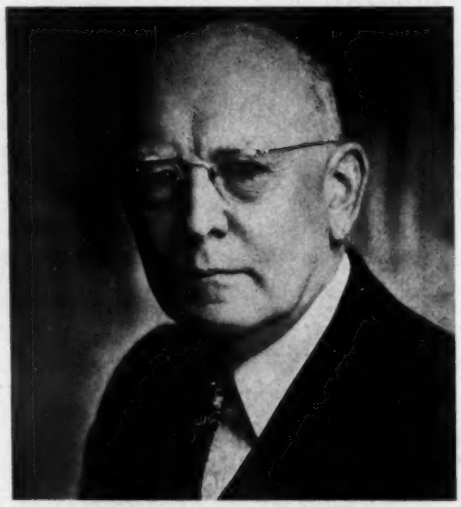


Fig. 6. 2,286,903: Dockerty. By confining a melting furnace in an air-tight jacket, low pressure compressed air may be used to draw glass fibers by a wiping action, as it escapes through a jet.



DR. CULLEN WARREN PARMELEE

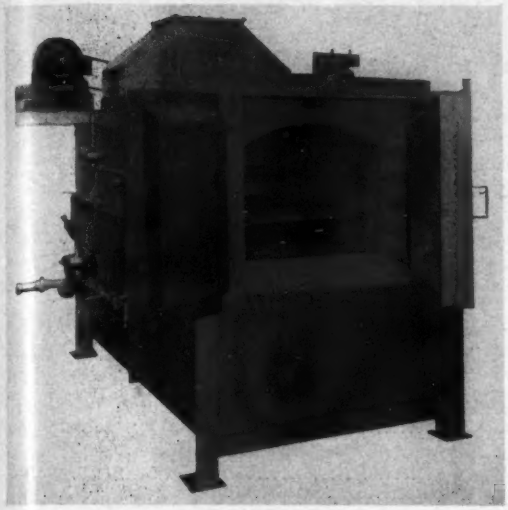
Cullen Warren Parmelee, professor and head of the Department of Ceramics at the University of Illinois, retires from his position this September after twenty years of service. He will be succeeded by Dr. A. I. Andrews.

A life member and ex-president of the American Ceramic Society, Professor Parmelee was awarded the degree of Master of Science by his alma mater, Rutgers University, in 1926 and of Doctor of Science in 1936 in recognition of his professional and scientific attainments. As a teacher and scientist in the field of ceramics his outstanding leadership will continue to contribute lasting influence.

• The Refractories Division of the American Ceramic Society has scheduled its autumn meeting for August 27th, 28th and 29th. The meeting will be held at Dearborn Inn, Dearborn, Michigan.

• Edwin E. Balling, Jr., controller of the Latchford-Marble Glass Company, has been elected first vice-president of the Los Angeles Control of the Controllers Institute of America.

NEW EQUIPMENT AND SUPPLIES



NEW SC SMALL CAPACITY LEHR

The new SC lehr illustrated was originally designed for optical ware and is adaptable to general applications in the glass industry for annealing, re-annealing, heat treating and decorating. The shelf area of this unit is approximately 26" x 52". Three sizes are now available for 100, 200 and 400 pounds of work per charge.

Automatic control of temperature and its re-circulation feature are important factors in the satisfactory operation of this furnace. The automatic control is a Bristol type recording time-temperature controller with time cam mounted in a separate case and was selected on the following anticipated mode of operation:

1. After starting up cold, or from the end of the preheating-cooling cycle, the furnace will be rapidly heated to a temperature somewhat below the desired annealing temperature.
2. During the charge period, the furnace will be held at the above temperature by the automatic temperature controls.
3. When charging by hand is complete, the control instrument will be manually set to the desired annealing temperature. At the same time, the cycle cam will be set to the starting position.
4. The automatic cycle control will thereafter hold the furnace at the annealing temperature and subsequently cool it through a predetermined time-temperature cycle, cutting down the fuel supply and opening up the cooling valve as required. The predetermined cycle will then be maintained until the desired discharge temperature is reached, or until the cooling rate reaches maximum capacity of the recirculating fan.

During the loading period the furnace is maintained at intermediate temperature between 600 and 900° F. When the loading is completed, the temperature is raised to the desired annealing temperature, up to a maximum of 1250° F. This temperature is held long enough to equalize heating throughout the load, cooling through the critical range on a predetermined time-temperature curve and thereafter cooling to the desired discharge temperature.

Gas fuel is introduced into the furnace by means of a single burner unit, comprising one main burner and one pilot burner. Combustion air is required at 16 ounces pressure. A high temperature recirculating fan of heat-resisting allow construction and equipped with a 3 h.p. motor is used to draw spent flue gases from an opening at the top of the oven, deliver these gases through a duct in the back wall of the oven, to a point where they mix with the hot products of combustion from the burner, and introduce the heated mixture into the work heating chamber suitable openings below the hearth level.

In connection with the recirculating fan, there is provided a four-way valve unit arranged to introduce controlled amounts of cooling air during the latter portion of the cycle to accelerate the temperature drop. The burner equipment has a maximum capacity of approximately 500 cubic feet of 875 Btu mixed gas per hour.

ACID PROTECTIVE PAINT

A highly chemical proof paint which is claimed to withstand the attack of hydrofluoric acid mixed with sulphuric acid is now being marketed by the Harrington Paint Co., Inc., of East Cleveland, Ohio. Known as Rust Eeter 66, the new product is made from domestic raw material. No primer is necessary and it will dry in 30 minutes. The resistance of the paint doubles with each additional coating.

LOOSE PULLEY OILER

For use on loose pulleys, idler pulleys, clutches, eccentrics, and similar rotating machine parts, a new wick type lubricator has been announced by the Oil-Rite Corporation. It is designed to deliver a constant, positive, and regulated amount of filtered oil to shaft or bearing while pulley is in operation, and to prevent oil waste when pulley is idle. The reserve supply of oil is always visible.

A simple glass oil reservoir, mounted on a hollow metal stem, is separately sealed except for two small ports at the top. Inside the stem is a cylindrical felt wick, which extends through the pulley hub to rest directly on the shaft. A compression spring is wrapped around the wick to hold it firmly in position against the shaft.

As the pulley rotates, and the lubricator with it, centrifugal force throws the oil against the top of the reservoir, and into the two ports in the stem. These admit oil to the wick, which filters out all dirt and sediment, and conducts the oil directly to the face of the shaft. Five standard sizes are available.

THREE-REFLECTOR FLOODLIGHT

A new steel L-68 floodlight offering a choice of 3 reflectors has been announced by the Lighting Division of G-E. The reflectors are (1) a chromium-plated reflector for narrow beam widths, (2) a painted steel reflector for wider beam widths, (3) an internal silvered glass reflector that is 10 per cent to 35 per cent more efficient than metal-reflecting surfaces. The reflector feature makes the unit applicable for all types of floodlighting problems.

Cast iron is used for the socket housing. Between the housing and reflector an asbestos gasket keeps the floodlight dry. Door glass is available in plain or stippled convex heat-resisting glass, or the floodlight may be operated as an open-type unit. Accommodates 750, 1000, and 1500-watt general-service lamp.

CATALOGS RECEIVED

Fatigue of Metals. The Nitralloy Corp., New York City. This, the second edition, is an excellent treatise on the many aspects of metal fatigue. Written primarily for the designing engineer it contains a number of subjects of special interest to glassmen including: shock resistance in metals; temperature and its secondary effects on causes of fatigue; internal stresses; fatigue and mortality of metals and engineering structures; engineering designs based on fatigue.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	50.00	55.00
Precipitated material		55.00	60.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)			
Granulated	In bulk, ton	42.50	....
Granulated	In bags, ton	46.00	57.00-62.00
Powdered	In bags, ton	51.00	62.00-67.00
Boric acid (H_3BO_3)			
Granulated	In bulk, ton	96.50	
Granulated	In bags, ton	100.00	112.00-117.00
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al F_6$) Natural Greenland (Kryolith)	lb.	.09½-.09¾	.10
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.			
Fluorspar (CaF_2) domestic, ground, 96-98% (max. SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	34.00	....
In bags	ton	36.40	50.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0900	....
In 5 Ton lots	lb.	....	.0950
Less than 5 Tons	lb.	....	.10
Lime—			
Hydrated ($Ca(OH)_2$–MgO) (in paper sacks)	ton	8.50	9.50
Burnt (CaO–MgO) ground, in bulk	ton	7.50	....
Burnt, ground, in paper sacks	ton	9.50	9.50
Burnt, ground, in 280 lb. drums	Per drum	2.35	2.35
Kiln Dried ($CaCO_3$–$MgCO_3$) 10x30 mesh	ton	2.00	....
Kiln Dried ($CaCO_3$–$MgCO_3$) 16x20 mesh	ton	2.00	....
Nepheline Syenite, f. o. b. shipping point In bulk,	ton	12.00	15.00
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	21.00-22.00	28.00-30.00
in bulk		17.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	.95	....
In barrels	Per 100 lb.	1.35	....
In Paper bags	Per 100 lb.	1.10	
In Burlap bags	Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	Per 100 lb.	....	3.00-3.40
95% and 97%			
Bulk	Per 100 lb.	1.35	3.60-4.00
200 lb. bags		1.4675	....
100 lb. bags		1.5025	....

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.031-.034	.045
Aluminum oxide (Al_2O_3)		.07	.09
Antimony oxide (Sb_2O_3)	lb.	.15	.15½-.16½
Arsenic			
Glassmakers	lb.	.04¼	.04¾
Regular refined white	lb.	.04	.04½
Arsenic trioxide (As_2O_3) (dense white) 99% In barrels		.04-.04¼	.04½-.04¾
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite (20% Al_2O_3)	ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.09	.12
Tin Oxide (SnO_2) in bbls	lb.	....	Open price.
Titanium Oxide (ceramic grade)			
In bags	lb.	.14½	....
In barrels	lb.	.14¾	....
Zinc Oxide (ZnO)			
American process, bags	lb.	.07¼	.07½
White Seal, 150 lb. bbls	lb.	.09¾	.10
Green Seal, bags	lb.	.09	.09¼
Domestic White Seal, bags	lb.	.09½	.09¾
Red Seal, bags	lb.	.08½	.08¾
Zircon			
Refined Granular (Milled .01-.02c higher)		.05¾	.06

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.10-1.15
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.65
Chrome Oxide Green, 400 lb. bbls	lb.	....	.25-.28
Chromite (99% through 200 mesh)	ton	58.25	64.75
Chromite ore (air floated)	ton	58.25	64.75
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.20-.22
Black (CuO)	lb.	....	.19-.22½
Black prepared	lb.	....	Open price.
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.06½-.10
Black (Fe_3O_4)	lb.	....	....
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls	lb.	....	.16½
Lithium Carbonate	lb.	....	1.25
Manganese, Black Oxide African			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	.34-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.09½	.09¾-.10
Powdered	lb.	....	.10¼-.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21-.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) in 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07¼	.07½-.07¾
Sodium chromate (Na_2CrO_7) Anhydrous	lb.	.08¼	.08¾-.09½
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.65
Yellow	lb.	....	1.65
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.40	3.75-4.15
Flowers, in bags	Per 100 lb.	3.05	3.40-3.80
Flour, heavy, in 250 lb. bags	Per 100 lb.	2.95	3.30-3.70
Uranium oxide (UO_2) (black, 96% U_3O_8)			
100 lb. lots. Black	lb.	....	2.55
Yellow orange	lb.	....	1.65

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.075	.08
Pumice Stone,			
American Ground FFF, FF, F	lb.	.03	.04
0, 0½, ½, 1	lb.	.05¾	.05¾
Putty Powder	lb.	Open price.	
Rotten Stone (Domestic)	lb.	.02¾	.03½
Rouge, Red	lb.	.18	.16
Black	lb.	.15	.18

CURRENT STATISTICAL POSITION OF GLASS

June witnessed a slowing down of activity in the glass industry from recent record rates with production, employment and payrolls returning close to last year's levels. According to the Glass Industry's Production Index, glass output during June amounted to approximately $40,000,000 as compared to $39,000,000 in last year's comparable month. Cumulative totals for the first half of this year indicate an output estimated at $250,000,000 as compared to $217,000,000 in last year's comparable period—an increase of 15 per cent.

Plate glass production during June amounted to 4,726,097 square feet, according to the Plate Glass Manufacturers of America. This was 8 per cent more than the previous month's total, but was 74 per cent less than the June, 1941, volume. During the first half of this year plate glass production totalled 34,914,489 square feet—68 per cent under last year's level.

Window glass production during June dropped 20 per cent from the May level to 1,222,940 boxes which represented 75 per cent of the industry's rated capacity. As compared with this, the June, 1941, production was 1,304,221 boxes, which was 80 per cent of the industry's rated capacity. During the first six months of 1942 window glass output totalled 9,102,000 boxes, or 9 per cent more than in 1941's corresponding period.

Glass container production during June amounted to 6,722,950 gross, according to the Glass Container Association of America. This was 6 per cent less than the May volume but was 9 per cent more than the June, 1941, total. During the first half of 1942 glass container output reached the record volume of 40,494,000 gross—an increase of 28 per cent.

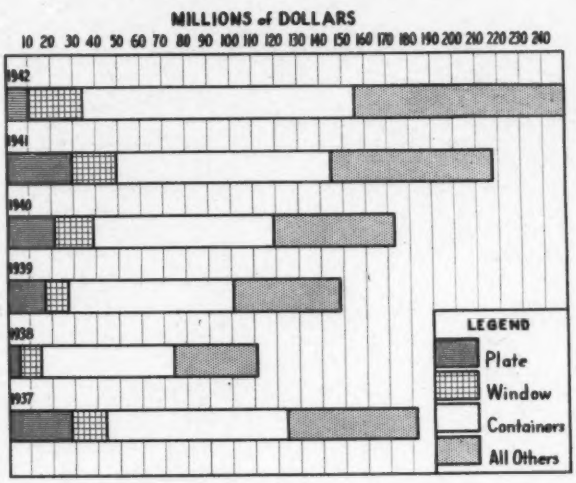
Shipments of glass containers during June were reported to have totalled 6,355,501 gross, or 7 per cent less than in last year's corresponding month. This trend was reflected in all lines with the exception of beer bottles (up 177 per cent) and milk bottles (up 5 per cent). Domestic jelly glasses dropped 59 per cent, domestic fruit jars 44 per cent, pressure and non-pressure ware 39 per cent, liquor ware 28 per cent, medicinal and toilet ware 13 per cent, narrow neck food containers and general purpose ware 10 per cent, pressed food ware 8 per cent and wide mouth food jars 5 per cent. Shipments during the first half of 1942 amounted to 39,291,341 gross which was 21 per cent more than in 1941. All lines, with the exception of pressure and non-pressure ware, which was off 13 per cent, followed this upward trend. Beer bottles increased 127 per cent, narrow neck food containers and domestic fruit jars 49 per cent, domestic jelly glasses 42 per cent, wide mouth food jars 25 per cent, medicinal and toilet ware 12 per cent, milk bottles 8 per cent and general purpose ware 8 per cent, liquor ware 4 per cent.

Inventories of glass containers in the hands of manufacturers on June 30, 1942, totalled 10,007,603 gross, or 19 per cent higher than on last year's corresponding date. Stocks of all types of ware, with the exception of domestic jelly glasses, pressure and non-pressure ware and beer bottles, were increased.

Miscellaneous glass products manufactured in June

GI THE GLASS INDUSTRY'S INDEX

Production Through June

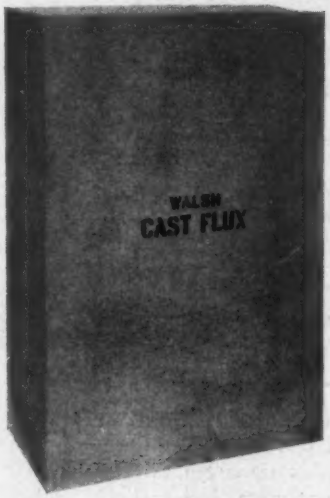


CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS)

Classifications	*Production*		*Shipments*		*End of Month Stocks*	
	June, 1942	*June, 1941*	*June, 1942*	*June, 1941*	*June, 1942*	*June, 1941*
Food Containers (Narrow neck, wide mouth, and pressed)	1,981,659	1,713,589	1,778,856	1,854,297	2,524,556	1,892,368
Pressure and Non-Pressure Ware	398,239	658,593	451,347	762,573	470,766	592,766
Beer Bottles	1,194,097	475,553	1,065,497	605,451	425,497	711,222
Liquor Ware	676,112	1,001,669	758,607	1,027,286	1,613,470	1,317,143
Medicinal and Toilet Ware	1,576,438	1,517,450	1,482,222	1,695,001	3,353,025	2,748,261
General Purpose	484,433	424,745	432,729	478,943	624,436	480,010
Milk Bottles	259,713	267,534	272,188	259,555	365,187	281,320
Fruit and Jelly	124,123	89,440	90,333	165,307	583,672	334,843
All Other	28,136	19,094	23,722	18,571	46,994	39,301
Total Industry	6,722,950	6.167,667	6,355,501	6,866,984	10,007,603	8,397,234

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street

St. Louis Missouri

are estimated to have totalled $15,000,000 or 25 per cent more than in last year's corresponding month.

Automatic tumbler production during June amounted to 3,778,534 dozens—20 per cent less than in last year's corresponding month. During the January-June period this output increased 8 per cent over 1941's comparable month to 27,221,000 dozens. Shipments of automatic tumblers during June totalled 3,845,489 dozens or 20 per cent less than in June of last year. Total shipments for the first half of 1942 were reported to be 25,316,518 dozens or about equal to last year's volume. Stocks on hand at the end of June amounted to 9,137,737 dozens.

Manufacturers' sales of machine-made table, kitchen and household glassware during June dropped 20 per cent below June, 1941, volume to 2,494,284 dozens.

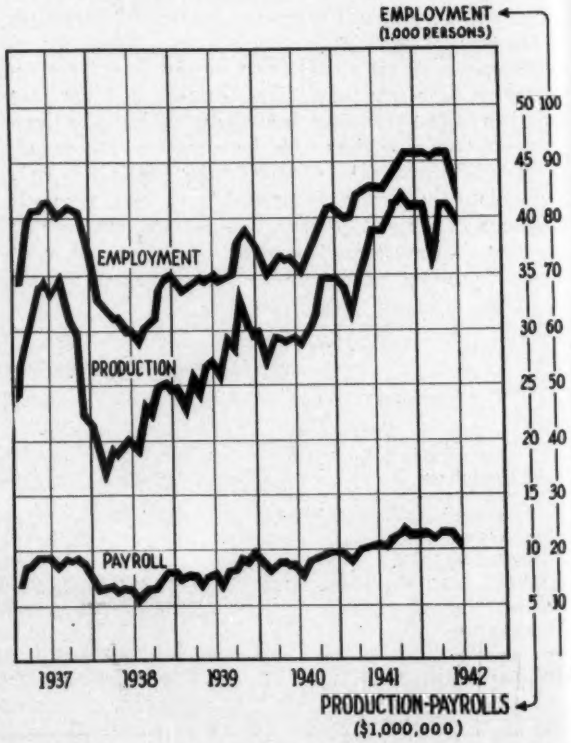
According to a preliminary report of the Bureau of Census, 12 illuminating glassware manufacturers reported sales totalling $651,000 during June which was 17 per cent under June, 1941, and 7 per cent under May, 1942.

Employment and Payrolls: Employment in the glass industry during June was estimated at 85,000 persons as compared to 92,000 in May and 86,000 in June, 1941.

Payrolls in the glass industry during June totalled approximately $11,500,000 as compared to $12,500,000 in May and $11,000,000 in June, 1941. During the first half of 1942 glass manufacturers paid out about $73,000,000 in wages as compared to $62,000,000 in last year's comparable period.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through June, 1942



BORAX *and the* HOME FRONT

American Blood for British Air Raid Victims.

How safe are YOUR FOLKS? Whether they sit peacefully at home in the suburbs —play in a neighborhood nursery—work in a war plant—or fight on land or sea,— this precious fluid may tomorrow save a life that is important to you, for neither accidents nor raids can be foreseen.

To ship Plasma wherever it may be required, sturdy containers are needed. Glass which can be so fragile, here takes on a more enduring role. In proportion to the amount of BORAX added to the batch, glass gains in strength and its resistance to heat and chemicals increases. This enhanced mechanical endurance minimizes losses in handling, trucking and conveying, an important consideration— especially when the contents of the glassware are of great value.

PACIFIC COAST BORAX COMPANY

DEPARTMENT G • 51 MADISON AVENUE • NEW YORK

NEW STAR PROJECTOR BUILT BY BAUSCH & LOMB

A new star projector has been built by Bausch & Lomb as an aid in teaching celestial navigation to the rapidly expanding aviation personnel at the Ground School of the U. S. Naval Air Station at Pensacola, Florida. The instrument projects 145 navigational stars on a spherical dome, providing a means of identifying these stars by their position and degree of brightness. Since the stars appear realistically in the sky through a period corresponding to a 24 hour cycle, instruction is speeded up by the ability to use the projector in daytime as well as during bad weather.

At the center of the instrument is a light source surrounded by a concentric sphere, 3¼" in diameter, in which 145 minute pinholes have been drilled in three different sizes, representing three different star magnitudes. Surrounding this inner sphere is a larger one containing 145 lenses, each lying along the same radius as its corresponding pinhole in the inner sphere. A stationary hemisphere surrounds the lower half of the sphere and conceals the stars as they reach the horizon. The light source and two spheres rotate as a unit about an inclined axis tilted so that the stars appear as in the sky. The axis of rotation supporting the projector is hollow permitting a cooling draught of air to be blown around the light source.

Celestial navigation is becoming increasingly necessary as the cruising range and altitude of planes are increased. It serves as a check on dead reckoning when marker beacons, radio beams, and landmarks are left behind and consists in establishing lines of position and obtaining a "fix" by observing two or more celestial bodies, or by taking several observations of the same celestial body. In obtaining a line of position from a celestial body, certain observations are made from the observer's actual position, certain values for the body are computed from an assumed position, and the results of these two operations are combined and compared.

ACTION IN THE MIDDLE EAST

Captain John T. Ogden, serving with the American Field Service attached to the British Middle East Armies, reports an incident of the current campaign which should be of interest to glassmen. It seems that during one of the see-saw battles which have been going on in Egypt, a British Ambulance became immobilized deep in enemy territory. A call was made for volunteers at A. F. S. headquarters in Cairo to go and do the rescue job. First to volunteer was Charles Shoneman, son of Mr. S. T. Shoneman of Columbia Alkali Division, Pittsburgh Plate Glass Co. Young Shoneman at the risk of capture completed his mission with complete success returning to G. H. Q. with the crippled British Ambulance in tow.

WPB ALLOCATION OF LITHIUM COMPOUNDS

WPB announces a complete allocation system for lithium compounds starting September 1st. Order M-191 provides for monthly requests for lithium compounds on Form PD-585 and reports from producers on PD-586. Deliveries of 25 pounds or less in any month are exempted from the restrictions. Lithium compounds are widely used in war equipment manufacture, particularly in shock-proof and temperature-resistant glass.

CONVERSION TO GLASS PROGRAM PUBLISHED BY WAR ACTIVITIES COMMITTEE

The War Activities Committee of the glass container industry has issued an illustrated booklet graphically showing the savings that can be effected in tin and steel by the packaging of essential products in glass instead of metal cans.

The booklet is primarily a handbook prepared for certain sections of WPB concerned with packaging and is based on the original Order M-81 issued last February specifying the allotment of tinplate, and on Order M-86-A providing for additional tinplate for government use. Some of the figures and details are already out-dated but the basic facts remain true. The productive capacity of the industry is now estimated at 94 million gross instead of 86 million gross. The amount of rubber required for gaskets has been considerably reduced.

Liquids may be packed in glass containers entirely without the use of rubber and requiring from one thirtieth to one fiftieth the metal needed for cans. Much of the packaging equipment now installed can be used or easily adapted for glass. The report also shows that as much as 357,000 tons of steel may be saved by transferring to glass containers approximately 40 per cent of the products for which cans are permitted. A special study is made of twelve groups of products which are readily convertible to glass packaging and which would ordinarily be packed in wide-mouth glass containers with rubber. In addition a calculation is made of the amount of steel, tin and rubber saved by packaging certain other products in either wide-mouth or narrow neck glass containers without rubber.

The total savings of this program in steel alone would be sufficient to build 115 Liberty ships.

PRIORITIES POWERS TRANSFERRED TO OFFICE HEADED BY AMORY HOUGHTON

The priorities powers formerly exercised by the Director of Industry Operations have been transferred to the newly created office of the Director General for Operations under an amendment of WPB Regulation No. 1. Announcement of the structure and top ranking personnel of the new Office of Operations which is headed by Amory Houghton, Chairman of the Board of the Corning Glass Works and formerly President, is expected shortly.

Mr. Houghton's plans call for the complete coordination of the new office, which will integrate the work of the materials and industry branches and the priorities system, with the Requirements Committee whose plan is the principal method of granting priority assistance to all industry.

CHROME ORE SUBSTITUTE

As a substitute for chrome ore in imparting color to glass, a new product has been developed and manufactured by the Martin Dennis Company of Newark, N. J. The product comes from the chromium-containing residue from the roasting of chrome ore in the production of sodium chromate after the sodium chromate has been extracted. It is then dried, pulverized and airfloated.

WANTED: Second hand small size glass batch mixing machine with a capacity of approximately 800 to 1400 lbs. of dry batch. Box 52, The Glass Industry, 55 West 42nd Street, New York, N. Y.

COLORED GLASSES . . .

(*Continued from page* 303)

Specimen Calculation of ϵ

Let T, transmittance factor, be 0.888, as in Glass V in Table I, for the 30-mμ. band centered at wavelength 520. Then log T is $\bar{1}.9484 = -0.0516$, and d, $= -\log T, = 0.0516$. $\epsilon = \frac{d}{c} = \frac{.0516}{.0487} = 1.07$.

TABLE II.

	Values of ϵ for Cr at wavelengths:				
Glass	*470*	*520*	*580*	*600*	*650*
I	3.50	1.13	1.21	1.98	3.62
II	3.54	1.19	1.28	2.03	3.65
III	3.32	1.07	1.15	1.85	3.40
IV	3.33	1.05	1.08	1.83	3.40
V	3.35	1.07	1.16	1.88	3.50
VI	3.17	1.01	1.10	1.80	3.28
VII	3.21	1.02	1.09	1.87	3.30
VIII	3.19	1.03	1.09	1.80	3.30
IX	3.33	1.07	1.17	1.85	3.39
Average	3.33	1.07	1.15	1.88	3.43

Cobalt-Blue Glasses

A second series of melts and measurements was made with cobalt oxide as the colorant, with results as tabulated below.

TABLE III.

			Transmittance for 1-mm. thickness, at wavelengths:				
Glass	*%Co_3O_4*	*c*	*470*	*520*	*580*	*600*	*650*
I	0.03	.00305	.946	.832	.776	.729	.739
II	0.05	.00508	.916	.742	.658	.591	.611
III	0.10	.01017	.861	.552	.433	.352	.374
IV	0.15	.01525	.809	.426	.307	.220	.240
V	0.20	.02033	.738	.318	.211	.139	.153
VI	0.35	.03558	.535	.115	.059	.027	.032
VII	0.40	.04066	.487	.088	.041	.016	.020
VIII	0.45	.04575	.425	.056	.024	.009	.012
IX	0.50	.05083	.382	.050	.021	.008	.009

TABLE IV.

	Values of ϵ for Co at wavelengths:				
Glass	*470*	*520*	*580*	*600*	*650*
I	7.91	26.2	36.1	45.1	43.1
II	7.50	25.5	35.8	45.0	42.1
III	6.40	25.4	35.8	44.6	42.0
IV	6.04	24.4	33.7	43.2	40.7
V	6.51	24.5	33.3	42.3	40.2
VI	7.63	26.4	34.6	44.1	42.0
VII	7.69	26.0	34.2	44.2	41.8
VIII	8.59	27.4	35.5	44.6	42.0
IX	8.24	25.7	33.1	41.4	40.0
Average	7.39	25.7	34.7	43.8	41.5

Conclusion

These values for extinction coefficients are sufficiently constant to show the validity of Beer's Law, within the limits of experimental error. This is particularly true for the chromium values. The values for cobalt show much scattering, but none that is consistent enough to throw any doubt on the principle. It is evident that greater refinement of method would be necessary, in order to get reliable numbers for cobalt.

Finally, it must be remarked that ϵ for any element is a constant only for a given type of glass, and for a narrow range of composition, also, only for a fixed state of oxidation.

The establishment of accurate sets of extinction coefficients for standard commercial glasses, together with practice in the use of these coefficients in calculation, would go far toward removing the making of colored glasses from the field of empiricism.

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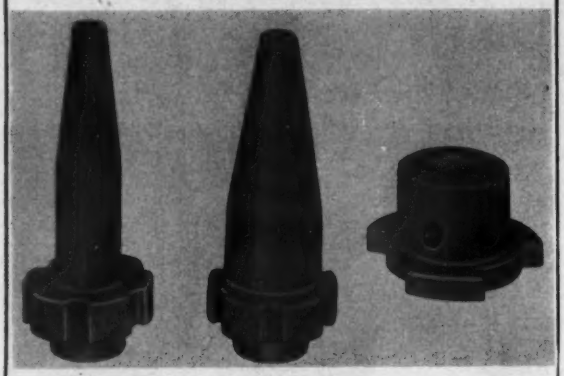

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FOAM GLASS

(*Continued from page* 305)

However that may be, it appears to be obvious that a glass of true sponge structure could be only obtained when arbitrarily controlling the pressure and viscosity relations and not under chance conditions as in the case of a cake where the increase in pressure is accompanied by the solidification of the walls.

Carbon or carbonaceous substances and carbonates are the most important gassing agents used. The action of carbon or carbonaceous products may be twofold. They may act by combustion or lead to gas evolution by reaction with the glass or substances mixed with the glass for that purpose. Some of the carbon, as a rule, will react with the sulfates which are usually to be found to some extent in glasses. Where gas evolution by reduction of sulfates in the glass or mixed with the glass is desired carbonaceous materials may be used interchangeably with other reducing agents such as silicon, ferrosilicon or carborundum. If carbon is used, for example, a reaction of the following type will occur:

$$C + SO_3 \longrightarrow CO + SO_2$$

Such reducing agents also may be used to reduce other constituents of the glass, such as oxygen compounds of arsenic, cadmium, zinc or lead, so as to convert them into substances having a high vapor pressure which will cause foaming of the glass.[44]

The mechanism of the action of gassing agents like calcium or magnesium carbonate or barium sulfate is readily understood. In the softening range or at temperatures above it such substances will react with the glass, while carbon dioxide or sulfur trioxide will be split off.

Of great theoretical interest are methods according to which gassing agents are used which on solidification of the glass will also solidify, so that vacuoles are formed rather than gas bubbles. Such glasses should have greatly increased heat and sound insulating properties.

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[7]The Role of Gases in Glass. W. A. Weyl & A. G. Pincus. Glass Ind., Nos. 7, 9, 11, 12 (1938).

[8]Dissolved Gases in Glass. E. W. Washburn, F. F. Footitt & E. N. Bunting. Univ. Illinois Eng. Expt. Sta. Bull. No. 118 (1920).

[11]Hot Water and Soft Glass in their Thermodynamic Relations. C. Barus. Amer. J. Sci. 9 ( ) 161-75 (903).

[42]1,967,375 of July 24, 1934 (June 15, 1932). Porous Refractory Material and Method of Making Same. G. Slayter (Owens Illinois Glass Co.).

[43]2,143,951 of Jan. 17, 1939 (Jan. 24, 1935; in France Jan. 27, 1934). Method and Apparatus for the Manufacture of Cellular Glass. R. Lambert (St. Gobain); see Brit. 433,423, French 45,417; Ger. 657,606.

[44]533,763 of Feb. 19, 1941. Multicellular Glass. St. Gobain.

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